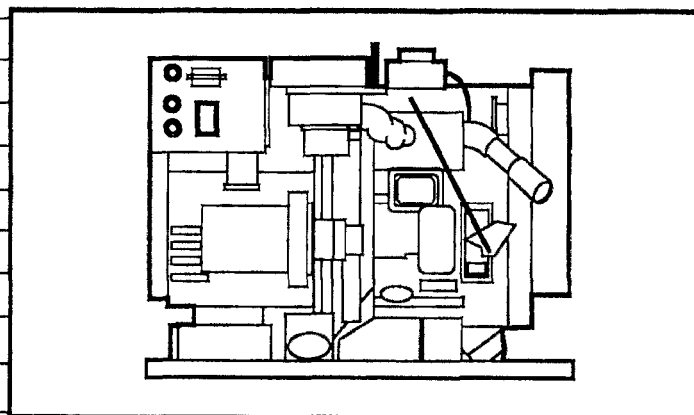
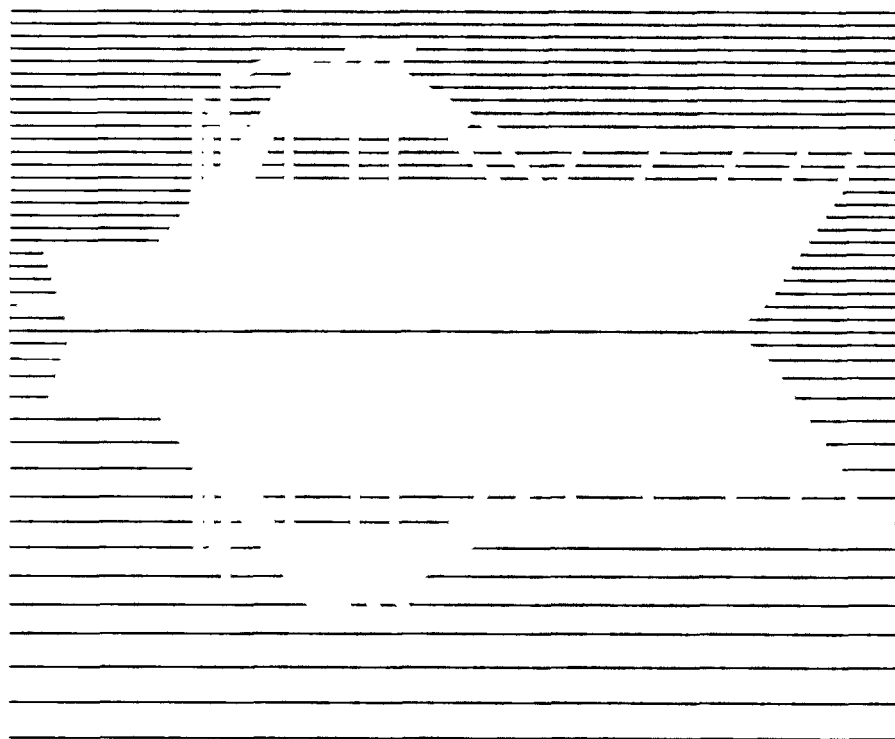


Installation Manual

MAJB



Safety Precautions

Before operating the generator set, read the Operator's Manual and become familiar with it and your unit. **Safe and efficient operation can be achieved only if the unit is properly operated and maintained.** Many accidents are caused by failure to follow fundamental rules and precautions.

Throughout this manual you will notice symbols which alert you to potentially dangerous conditions to the operator, service personnel, or the equipment itself.

▲ DANGER *This symbol warns of immediate hazards which will result in severe personal injury or death.*

▲ WARNING *This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.*

▲ CAUTION *This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.*

FUEL, ENGINE OIL, AND FUMES ARE FLAMMABLE AND TOXIC. Fire, explosion, and personal injury can result from improper practices.

- Benzene and lead, found in some gasoline, have been identified by some state and federal agencies as causing cancer or reproductive toxicity. When checking, draining or adding gasoline, take care not to ingest, breathe the fumes, or contact gasoline.
- Used engine oils have been identified by some state or federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.
- Do not fill fuel tanks with the engine running. Do not smoke around the generator set area. Wipe up any oil or gas spills. Do not leave oily rags in engine compartment or on the generator set. Keep this and surrounding area clean.
- Inspect fuel system before each operation and periodically while running.
- Equip the engine fuel supply with a positive fuel shutoff.
- Always disconnect the battery ground (–) lead first and reconnect it last. Make sure you connect the battery correctly. A direct short across the battery terminals can cause an explosion. Do not smoke while servicing batteries. Hydrogen gas given off during charging is very explosive.
- Keep a fire extinguisher available in or near the engine compartment and in other areas throughout the vessel. Use the correct extinguisher for the area. For most types of fires, an extinguisher rated ABC by the NFPA is available and suitable for use on all types of fires except alcohol.

EXHAUST GASES ARE DEADLY

- Provide adequate ventilation. Equip the bilge with a power exhauster.
- Be sure propulsion and generator set engine exhaust systems are free of leaks. Perform thorough, periodic inspections of the exhaust system and repair leaks immediately. Exhaust gases are deadly.
- Never sleep in the vessel with the generator set running unless the vessel is equipped with an operating carbon monoxide detector.

HOT COOLANT CAN CAUSE SEVERE PERSONAL INJURY

- Hot coolant is under pressure. Do not loosen the coolant pressure cap while the engine is hot. Let the engine cool before opening the pressure cap.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not remove any belt guards or covers with the generator set running.
- Keep hands and loose clothing away from moving parts. Do not wear jewelry while servicing any part of the generator set.
- Never step on the generator set (as when entering or leaving the engine compartment). It can stress and break unit components, possibly resulting in dangerous operating conditions... from leaking fuel, leaking exhaust fumes, etc.
- Before performing any maintenance on the generator set, disconnect its batteries to prevent accidental starting. do not disconnect or connect battery cables if fuel vapors are present. Ventilate the generator set compartment or bilge thoroughly with the power exhauster.

ELECTRICAL SHOCK WILL CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not make adjustments in the control panel or on engine with unit running. High voltages are present. Work that must be done while unit is running should be done only by qualified service personnel standing on dry surfaces to reduce shock hazard.
- DO NOT CONNECT THE GENERATOR SET TO THE PUBLIC UTILITY OR TO ANY OTHER ELECTRICAL POWER SYSTEM. Electrocuting or damage to property can occur at a site remote from the boat where line or equipment repairs are being made if the set is connected to the power system. An approved transfer switch must be used if more than one power source is to be made available to service the boat.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.

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Section 1. Introduction

GENERAL

Each marine genset must be installed properly if it is to operate reliably, quietly, and most importantly—safely. Therefore, read this entire manual before starting the installation. The manual should be used only as a guide, as each installation must be considered on an individual basis. For operation and maintenance procedures, refer to the MAJB Operator's Manual 933-0121 which accompanies each unit.

Proper installation is very important. Requirements to consider include:

- Adequate cooling air
- Adequate combustion air
- Discharge of exhaust gases
- Discharge of circulated air
- Electrical connections and bonding
- Fuel connections
- Sea water connection
- Accessibility for operation and servicing
- Level mounting surface
- Adequate support under mounting points
- Noise levels

INSTALLATION CODES AND SAFETY RECOMMENDATIONS

The installation must follow recommendations of the American Boat and Yacht Council (ABYC) and the National Fire Protection Association (NFPA).

The installer should be familiar with and follow the appropriate guidance found in the following publications:

ABYC *"Safety Standards for Small Craft"* from:

ABYC
15 East 26th St.
New York, NY 10010

NFPA302 *"Fire Protection Standard for Motor Craft"* from:

NFPA
470 Atlantic Ave.
Boston, MA 02210

USCG 33CFR183 from:

U.S. Government Printing Office
Washington, D.C. 20404

⚠ WARNING

INCORRECT SERVICE OR REPLACEMENT OF PARTS CAN RESULT IN SEVERE PERSONAL INJURY, DEATH, AND/OR EQUIPMENT DAMAGE. SERVICE PERSONNEL MUST BE QUALIFIED TO PERFORM ELECTRICAL AND/OR MECHANICAL SERVICE.

Section 2. Specifications

GENERATOR DETAILS

Type	Revolving Field, 2-pole
Rating @ 60 Hertz	3.0 kW (3.0 kVA @ 1.0 PF)
Rating @ 50 Hertz	2.5 kW (2.5 kVA @ 1.0 PF)
Frequency Regulation	3 Hz
Voltage Regulation	Inherently Regulated (Maximum 8%)

ENGINE DETAILS

Engine Type	Four Cycle, Single Cylinder
Engine Speed:	
60 Hertz	3600 r/min
50 Hertz	3000 r/min
Exhaust Outlet Hose Size, ID	1.5 in. (38 mm)
Fuel Recommendation	Unleaded, 88 octane
Fuel Inlet Size	1/4-18 NPT
Fuel Consumption, Average @ Full Load:	
60 Hertz	0.81 gph (3.17 Lph)
50 Hertz	0.76 gph (2.98 Lph)
Battery Requirements:	
Voltage	12
Minimum Cold Cranking Amps @ 0°F (-18°C)	360
Starter Cranking Current	100 Amperes
Battery Charger Output	0.1 to 1.0 Amperes
Cooling System	
Coolant Flow Rate, New Pump, Thermostat Open:	
60 Hertz	1.8 gpm (6.8 L/min)
50 Hertz	1.5 gpm (5.7 L/min)
Heat Rejection @ Load	325 BTU/min
Sea Water Hose Connector Size, OD	0.75 in (19.0 mm)
Sea Water Pump Dry Lift, Maximum	3 ft (0.9 m)
Oil Capacity with Filter	2.0 quarts (1.9 L)
Total Air Required (Generator and Combustion):	
60 Hertz	76 ft³/min (2.2 m³/min)
50 Hertz	66 ft³/min (1.9 m³/min)
Spark Plug Gap	0.025 in (0.64 mm)
Ignition Timing	25° BTC

Section 3. Location and Mounting

LOCATION

The genset location must be a well ventilated area, insulated, close to the fuel supply and the center of electrical load distribution. Usually those conditions are in the same room or compartment as the propulsion engine. However, a genset cannot be installed in the propulsion engine compartment unless specific conditions are met.

USCG regulation 33CFR183 pertains to gasoline fuel systems, and requires a genset operating in a gasoline fuel environment to be "ignition protected." This means a set capable of operating in an explosive environment without igniting that environment. Properly installed and operated, the MAJB genset can operate in an explosive environment.

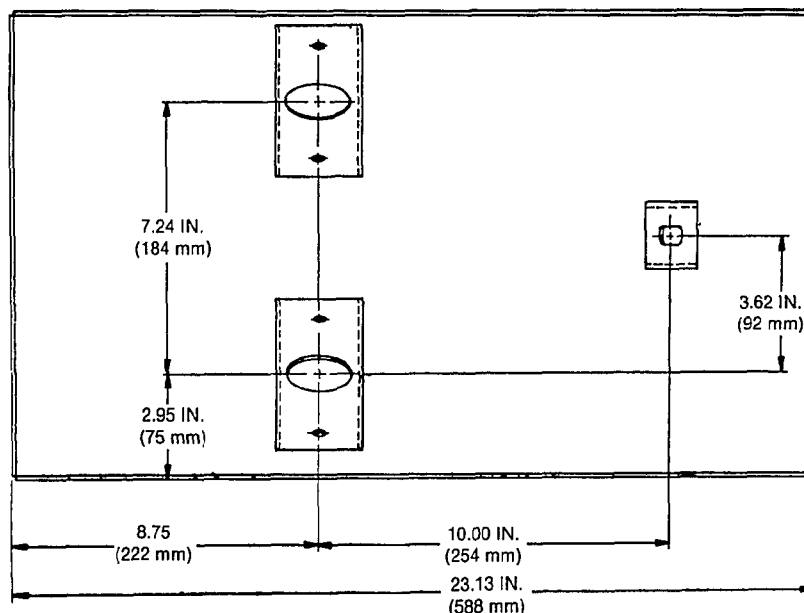
⚠ WARNING *Gasoline fire or explosion can result in severe personal injury or death. Do not install a gasoline generator set in the same room or compartment of a diesel propulsion engine or generator set. The diesel unit may not be ignition protected and can ignite gasoline fumes. Be sure a gasoline generator set is installed in its own room or compartment on a diesel boat.*

Select a location that will allow adequate space on all sides for ventilation and servicing the set, preferably on and parallel with the keel or vessel center line. Keep the genset away from living quarters, and away from bilge splash and vapors.

MOUNTING

The floor must be flat and give support directly under the genset mounting points (Figures 3-1 and 3-2). A one inch (25 mm) clearance around the unit is required to permit rocking on its mounts without restraint. Additional space must be allowed for proper ventilation for cooling and combustion, as well as service access. Also allow access for periodic maintenance such as oil fill, coolant fill, spark plug replacement, etc. The entire exhaust system must be accessible so a periodic visual and audible check for leakage can be made by the operator.

Install two hold-down clamps or two through bolts to the drip pan on both sides of the genset. Tighten the clamps securely to the mounting base with bolts and flat-washers.



M-1781

FIGURE 3-1. DRIP PAN DIMENSIONS

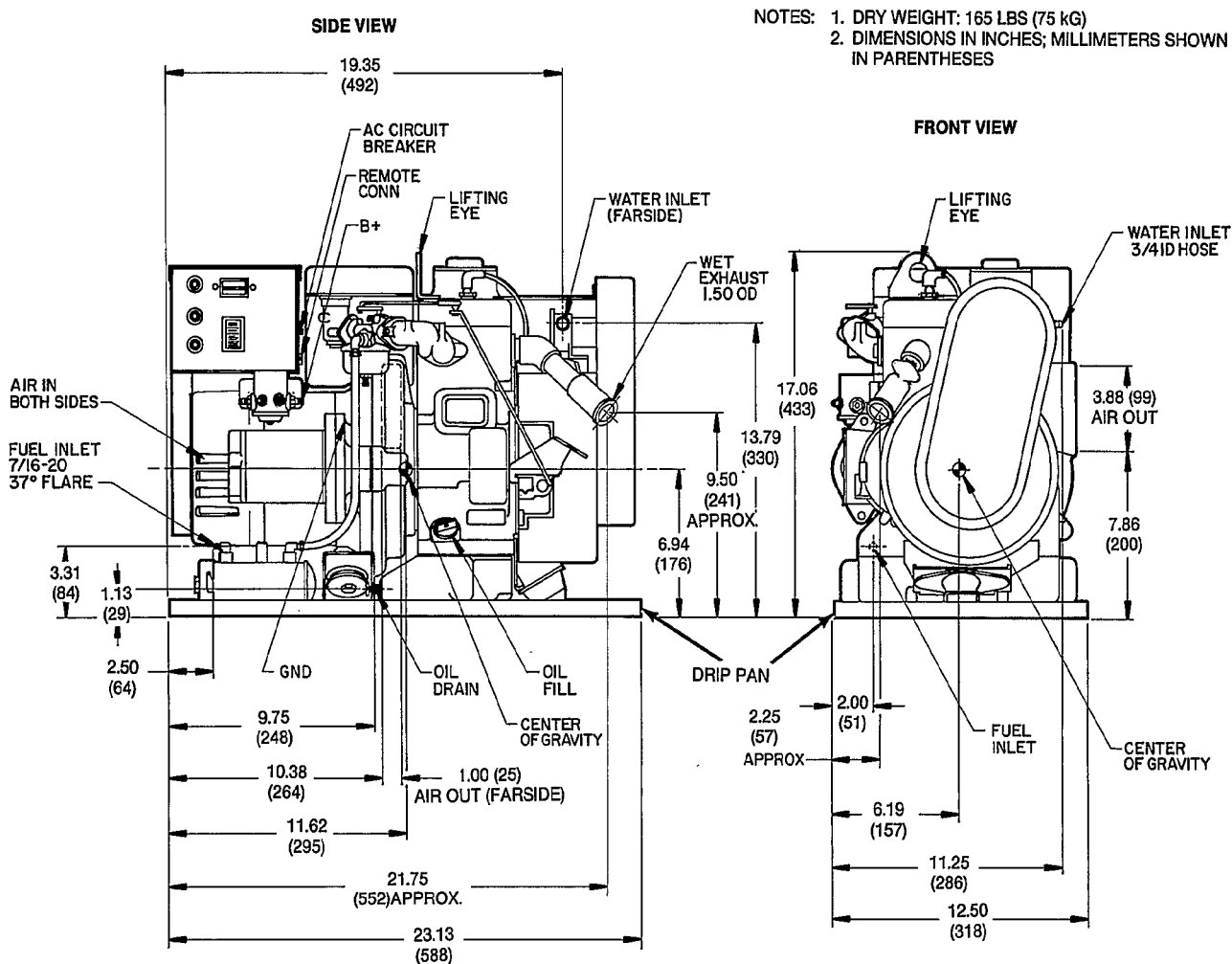
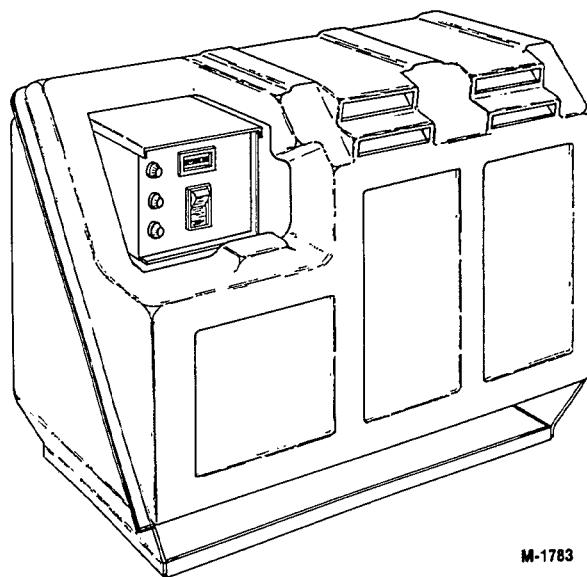


FIGURE 3-2. OUTLINE DRAWINGS

SOUND ATTENUATION HOUSING

The Onan housing, shown in Figure 3-3, is an option that is available for noise reduction. It is an insulated enclosure that partially surrounds the genset. Openings are provided for all external connections. Installation instructions are furnished with the housing. Contact the local Onan dealer or distributor for details.



M-1783

FIGURE 3-3. SOUND ATTENUATION HOUSING

Section 4. Ventilation

GENERAL

The installation of boat ventilation systems must meet all Coast Guard and NFPA requirements. Establishing the correct air flow quantity is particularly important with small compartments under 1000 cubic feet (28m³), or installations in close quarters. Ventilation systems meeting Coast Guard requirements for gasoline engines in passenger vessels (Table 4-1) will normally suffice, however special consideration must be given to compartment conditions during operation.

TABLE 4-1. PASSENGER VESSEL VENTILATION REQUIREMENTS

SIZE OF COMPARTMENT Cu. Ft. (m ³)	MINUTES REQUIRED TO EXCHANGE TOTAL AIR VOLUME
Less than 500 (14)	2
500 to 1000 (14 to 28)	3
1000 to 1500 (28 to 42)	4
1500 and Up (42 and Up)	5

REQUIREMENTS

Marine gensets must have air ventilation for three very important reasons:

- 1. To remove flammable or other harmful gases.** Coast Guard regulations require power blowers in the genset and propulsion engine rooms be run at least four minutes prior to starting the engine and during operation. The operator must also inspect the engine room for the presence of fuel vapors prior to starting, especially when gasoline fueled equipment is used (see text under Coast Guard and NFPA Requirements).
- 2. To provide engine combustion air and generator cooling air.** Coast Guard regulations require power exhausters in all installations, and one blower in each exhaust duct. Exhausters must have an air capacity 1-1/2 to 2 times the minimum genset total air requirements. The MAJB genset requires a total operation minimum of 76 cubic feet per minute (2.2 m³/min) @ 60 hertz; and 66 cubic feet per minute (1.9 m³/min) @ 50 hertz.
- 3. To control compartment temperature during genset operation.** This will avoid overheating which can result in shutdown from vapor lock, engine and related control component damage, and power loss. As a general rule, the operating environment

for a gasoline genset should not be higher than 140°F (60°C) maximum. Lower temperatures are recommended. Often an operating power blower may be required to maintain temperature when the genset is operating, especially when the boat is not moving.

The compartment must have air inlets and outlets to provide this air. Inlet ducts should have cowls or equivalent fittings of twice the area of the duct, larger if the opening is screened. Do not use recessed or flushed inlets, or louvered transom outlets.

If the gasoline fuel tank is in a separate compartment, it also must be ventilated.

COAST GUARD AND NFPA REQUIREMENTS

Both organizations require at least two inlet ducts and two outlet ducts extending to the bilge for gasoline genset installations in a closed compartment. When not in a closed compartment, at least one duct should be installed in the fore section of the boat and another aft. The NFPA recommends a vent size of at least two square inches per foot (42.3 cm²/m) of boat beam for total inlet area and total outlet area.

Boats classified as pleasure vessels by the Coast Guard must have sufficient ventilation to eliminate accumulation of flammable gases. Boats under 65 feet (20 m) long classified as passenger vessels require ventilation be sufficient to change the compartment air within a given time interval (Table 4-1).

For passenger vessels, the Coast Guard recommends a mechanical exhausting system to meet the requirement in Table 4-1. To prevent movement of fumes between living quarters and any compartment containing an engine or its exhaust system, seal all cracks, feed-through holes, and conduit ends.

If a gasoline fuel tank is in a separate compartment, it must be ventilated to the same requirements as the engine compartment.

Do not sleep in a vessel with the genset running unless a carbon monoxide detector is installed. A CO detector listed for marine use should be installed in the living quarters of the vessel. The many ventilation variables (such as wind shifts, boat in motion, at dockside where there can be exhaust gas from other vessels, etc.) make a CO detector an important accessory.

Section 5. Cooling System

GENERAL

Throughout this manual, flotation water drawn into the boat for engine cooling is called sea water. Thus, confusion is avoided with other generic terms describing water origin and use. The MAJB genset is available only with sea water cooling.

System Plumbing

To adequately cool the genset under all conditions, the plumbing system must be properly planned and installed. Excess lengths of plumbing increases flow resistance and results in reduced cooling. An air leak in the sea water intake will reduce cooling, cause corrosion, and can even destroy the neoprene impeller in the sea water pump. The neoprene impeller must never be run dry, and the pump should be primed before initial start.

The water line should have a minimum inside diameter of 0.75 inch (19 mm). For runs over 20 feet (5.2 m), increase the line one pipe size for each additional 10 feet (2.6 m) of length. Water lines can be either copper tubing or flexible hose. Be sure a length of flexible hose is used at the genset connection to allow set movement and for noise abatement.

Because sea water cannot be relied upon to always be very clean, Onan recommends a water strainer or filter to protect the engine cooling system. See Figure 5-1.

Onan has a hull strainer (furnished with some muffler kits) that can be used with a flush through-hull fitting. The strainer (Figure 5-1), installed with the slots parallel to the keel, helps prevent pressure or vacuum when the boat is underway. Always use a flush-type inlet with a hydrodynamic marine muffler.

CAUTION

Restriction in the sea water inlet line can cause engine overheating and shutdown. The flush-type, through-hull water inlet must have an opening at least as large as the water inlet line.

Stagger the genset water inlet so it is not directly in line with other inlets. Not doing so can reduce the amount of sea water available to the genset when underway and cause overheating. Never use scoop type water inlet fittings with a hydrodynamic muffler.

CAUTION

DO NOT USE SCOOP TYPE WATER INLET FITTINGS WITH A HYDRO-DYNAMIC MUFFLER. Forward facing scoops can develop sufficient ram pressure to force water past the generator set's sea water pump. This can flood the exhaust system and the engine cylinder. This happens when the generator set is not running and the boat is underway. Rear facing scoops develop vacuum which can impede cooling water flow.

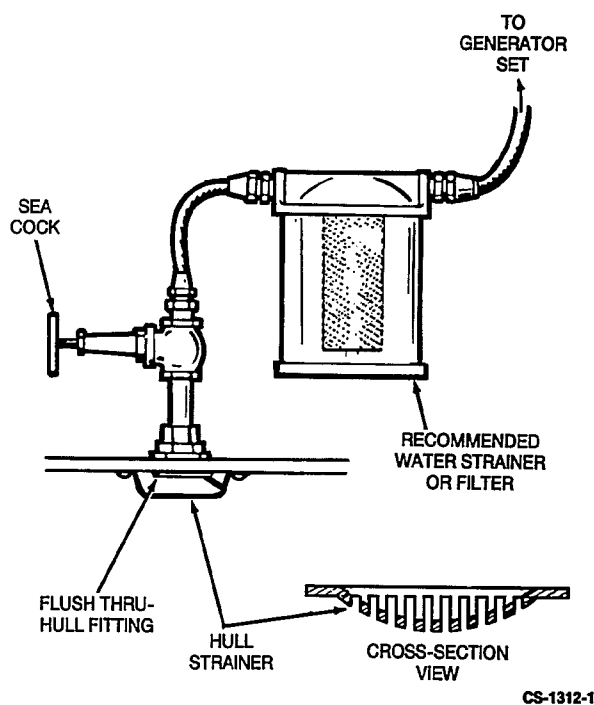


FIGURE 5-1 SEA WATER INLET

SEA WATER COOLING

Figure 5-2 shows sea water flow direction and hose connections. This system uses the belt-driven sea water pump to direct water through the engine cooling system and out the exhaust system. A thermostat is used to maintain engine operating temperature.

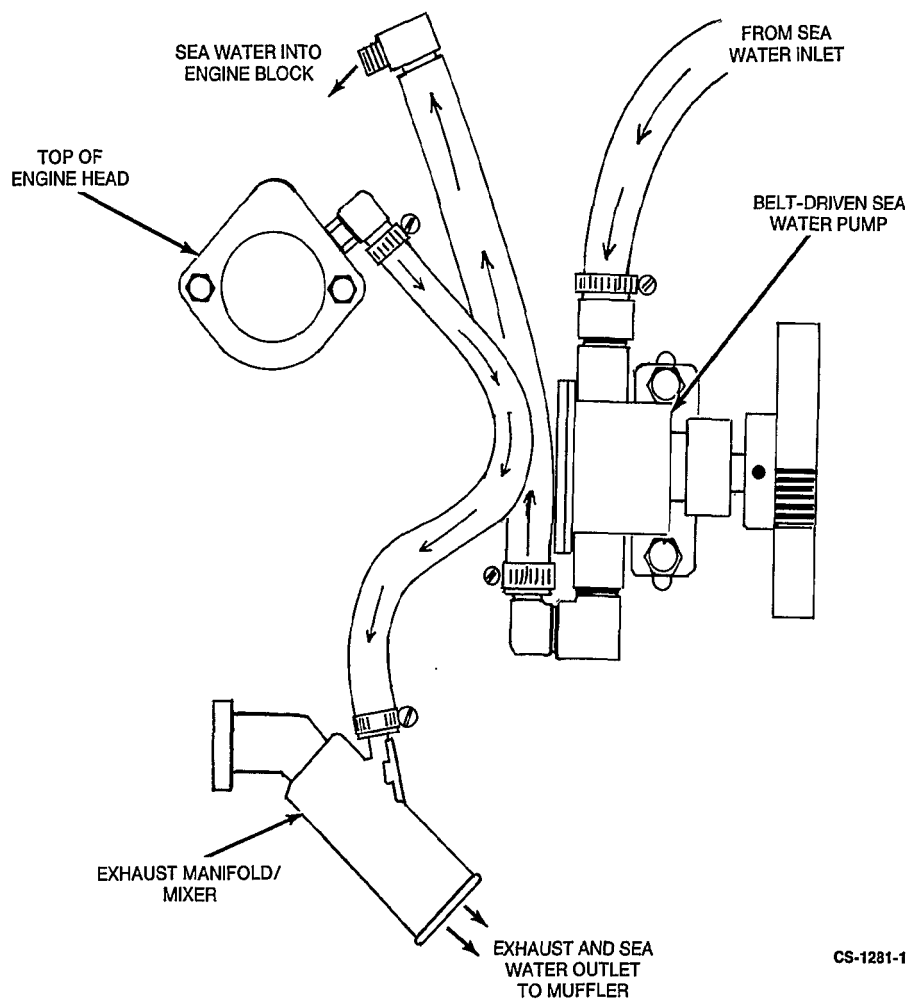
The engine block has a coolant bypass to allow some coolant flow regardless of thermostat opening. This allows for exhaust cooling, and protection of the pump. The sea water and engine exhaust are disposed of with a hydrodynamic muffler in above or below waterline design covered in the *Exhaust System* section.

COMBINED COOLING SYSTEMS

Onan does not recommend combining the genset cooling system with the propulsion engine cooling system. This involves a great amount of experience and knowledge for the installer, as well as complete knowledge of characteristics of both the genset and propulsion engines.

⚠ CAUTION

Propulsion engines use scoop-type water inlet fittings which must not be used for a generator set with a hydrodynamic muffler. When not operating, ram pressure can force water past the generator set sea water pump and flood the exhaust system. From here it can flow back, flooding the engine cylinders and possibly the engine compartment.



CS-1281-1

FIGURE 5-2. COOLANT FLOW, SEA WATER COOLING

Section 6. Exhaust System

GENERAL

The installation of two water-cooled exhaust systems are covered in this section. They are below-load waterline and above-load waterline, and are covered under separate headings. All marine water-cooled exhaust systems must meet each of the following requirements. Failure to meet these requirements could result in severe property damage, personal injury or death.

- The entire exhaust system must be accessible so a periodic visual and audible leakage check can be done by the operator.
- The exhaust system must be water cooled, and the water injected as near to the genset as possible.
- The exhaust line must be installed to prevent back flow of water to the engine under any conditions; and the exhaust outlet must be above the load waterline. Water backflow into the engine will damage it.
- The genset exhaust system **must not** be combined with the exhaust system of another engine.
- A flexible section of marine exhaust hose must be used near the engine to allow for engine movement and vibration during operation. All exhaust system hoses must be CERTIFIED for marine use.
- The exhaust system must be of sufficient size to prevent excessive back pressure. See Back Pressure data in this section.
- Make sure all sink, shower or other cabin drains are properly trapped to prevent entrance of exhaust gas.

Material

Use material recommended by ABYC in "Safety Standard for Small Craft," Section P1. The exhaust line must be at least as large as the engine exhaust manifold outlet. See the following section on *Back Pressure*.

⚠ WARNING *Exhaust gas contains carbon monoxide, an odorless, colorless, highly poisonous gas that presents the hazard of severe personal injury or death. Place special emphasis on the following:*

- *Be sure the flexible exhaust hose is designed and certified for marine exhaust line use.*
- *Use two clamps at each end of all flexible exhaust hose connections.*
- *Do not make sharp bends in the exhaust hose.*
- *Position exhaust outlet to prevent backflow of exhaust gases into the vessel.*

Use flexible hose designed and CERTIFIED for marine exhaust line use to ease installation, and for flexibility. The muffler must be at the lowest point of the entire exhaust system. The muffler inlet should be at least 12 inches (305 mm) below the engine exhaust manifold outlet. If this distance is less, backflow of water toward the manifold is more likely.

Make sure the hose drains toward the muffler at a minimum grade of 1/2 inch per linear foot (42 mm/m). An uphill section between the exhaust manifold and muffler can cause backflow of water and is not permissible - NO EXCEPTIONS.

Be sure that the vertical rise of the exhaust hose measured from the bottom of the muffler to its peak is not more than 48 inches (1.2 m) as shown in Figure 6-1.

The exhaust tubing (on both above and below load waterline installations) must be pitched downward to the through-hull outlet fitting at a minimum downgrade of 1/2 inch per linear foot (42 mm/m). There must also be a 12-inch (305 mm) minimum drop from this peak to the through-hull outlet fitting as shown in Figures 6-1 and 6-2.

Allow space between the marine muffler and its mounting surface by use of spacers under the mounting flanges. This allows air circulation under the muffler and discourages condensation.

Use two clamps at each end of exhaust hoses as shown in Figures 6-1 and 6-2. The clamps must be of corrosion resistant metal, a minimum of 1/2 inch (12.7 mm) wide. They should be spaced at least one clamp width apart, and at least one clamp width from the end of the hose. Clamps depending solely on spring tension must not be used.

Provide adequate support for hose lengths to prevent sagging, bending, and formation of water pockets. The use of automotive-type pipe hangers will help stop noise transmission to the boat hull.

Back Pressure

Exhaust back pressure is an important measure of an adequate exhaust system. If the exhaust installation requires a long run of pipe (more than 30 feet [9 m] overall), back pressure should be checked. Exhaust back pressure for the MAJB genset should not exceed 3.0 inches (76 mm) of mercury (10 kPa).

Increase the exhaust pipe diameter from the muffler to the hull outlet one standard pipe size for every 10 feet (3 m) beyond 30 feet (9 m) of overall length.

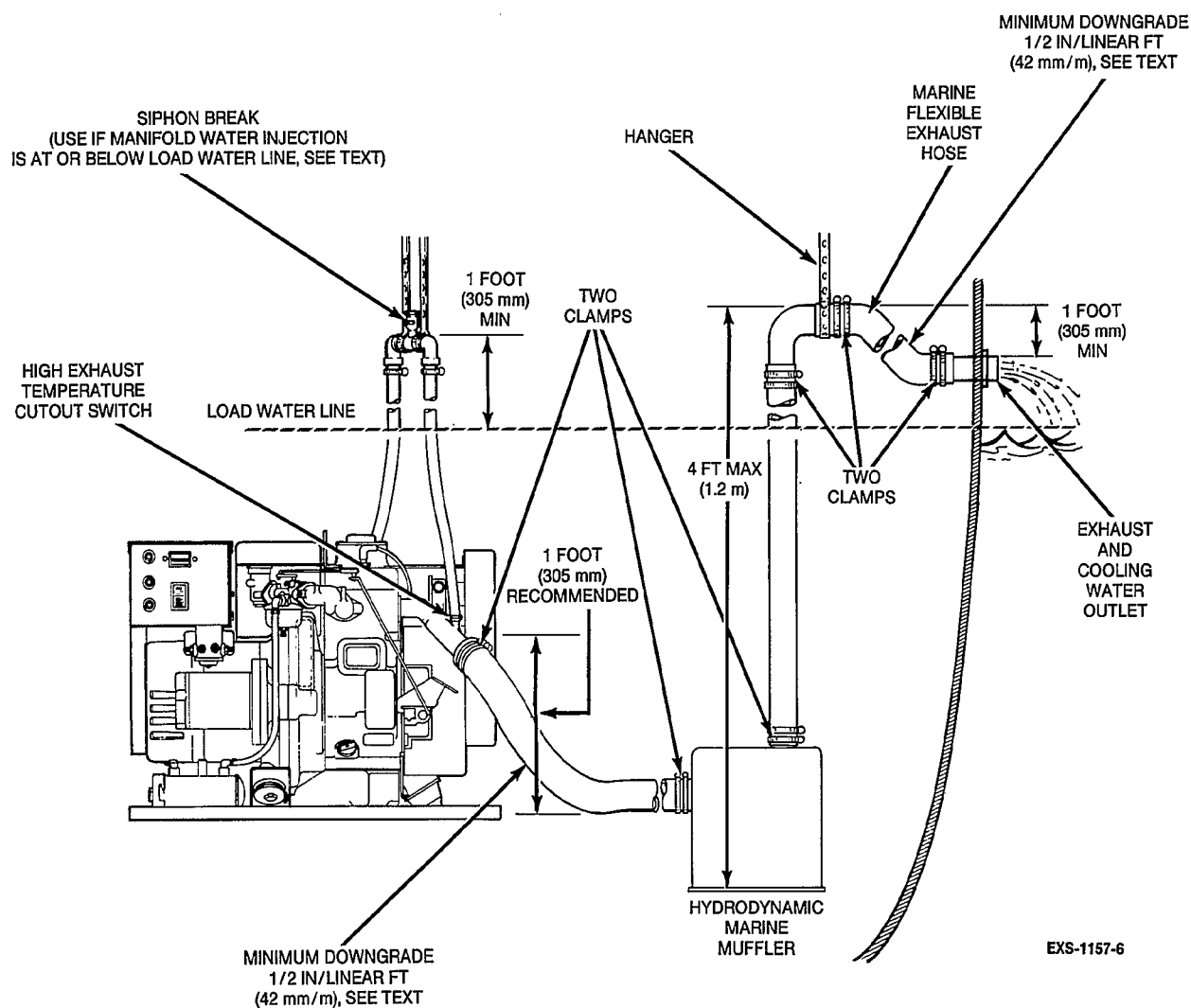


FIGURE 6-1. BELOW LOAD WATERLINE INSTALLATION

Exhaust Cooling Water Injection

The neoprene impeller pump moves the sea water through the cooling system and into the exhaust manifold. The injected water cools the exhaust and prevents exhaust system damage. A temperature operated switch on the exhaust manifold shuts the genset down if overheating occurs. The switch closes if temperature reaches 185° to 195°F (85° to 90°C) and actuates the Fault Reset breaker on the control panel.

If high exhaust temperature shutdown occurs, the entire exhaust system should be checked for any signs of overheating, especially the exhaust hoses. Replace defective components immediately, and do not operate the genset until system is repaired.

⚠ WARNING *Inhalation of exhaust gas can cause severe personal injury or death. Do not operate the generator set after a high exhaust temperature shutdown until the entire exhaust system has been checked and serviced as required.*

⚠ WARNING *DO NOT USE SCOOP TYPE WATER INLET FITTINGS. Forward facing scoops can develop sufficient ram pressure to force water past the generator set sea water pump. This can flood the exhaust system and the engine cylinders. This happens when the generator set is not running and the boat is underway. Rear facing scoops develop vacuum which can impede cooling water flow.*

BELOW LOAD WATERLINE INSTALLATION

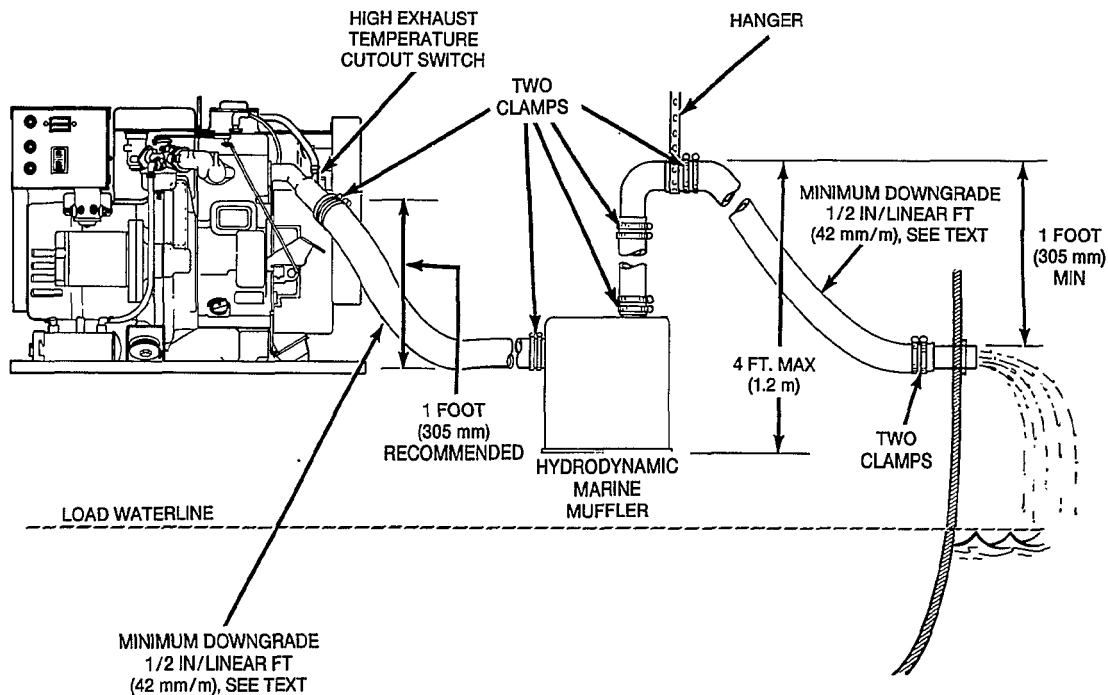
Figure 6-1 shows details of a recommended below load waterline installation. Review and apply data from the preceding GENERAL section, plus the following.

Siphon Break

Install a siphon break (anti-siphon) if the sea water injection port on the exhaust manifold is at or below the load waterline. The siphon break is a vacuum operated vent valve that opens the exhaust water discharge line to the atmosphere when the engine is not operating. The open vent valve prevents sea water (flotation water) from being siphoned into the exhaust manifold and cylinders of engines installed below load waterline.

The siphon break hoses connect between the exhaust manifold water injection port and the water outlet on top of the cylinder head. Connect the siphon break hose ends to these connectors.

Locate the siphon break in a vertical position at least 12 inches (305 mm) above the load waterline. See Figure 6-1. Remote mounting is permissible within a 5 foot (1.5 m) radius of the injection port. The vertical position and height of the valve must be maintained.



EXS-1157-7

FIGURE 6-2. ABOVE LOAD WATERLINE INSTALLATION

The siphon break must be mounted vertically with the threaded end pointed down. Use pipe strap material to secure the assembly to the frame or bulkhead. Be sure the slotted opening in the siphon break valve is open to atmospheric pressure. The valve will not function if the slot is closed in any way.



Failure to use a siphon break when the exhaust manifold injection port is at or below the load waterline will result in sea water damage to the engine and possible flooding of the boat.

ABOVE LOAD WATERLINE INSTALLATION

Figure 6-2 shows details of a recommended above load waterline installation. A siphon break valve is not required with this installation. Review and apply data from the preceding GENERAL section. Be sure the minimum drop and downward pitch of exhaust runs are applied, and that all hose end connections have two clamps as shown.

Section 7. Fuel System

GENERAL

⚠ WARNING *Fuel leakage in boats presents fire and explosion hazards that can result in severe personal injury or death. For this reason, it is important that the material, design, construction and installation of all fuel system components meet the highest possible standards. Use only products specified for marine application.*

Make sure all fuel lines are properly supported and connections tightened securely. Use an approved pipe joint compound acceptable for use with gasoline fuel at all thread fittings.

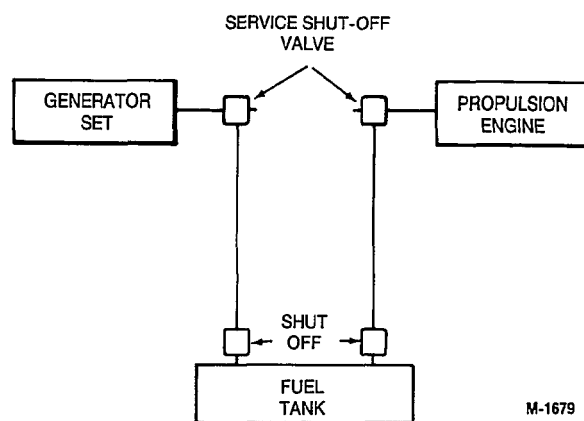
Fuel distribution lines must have as few connections as practicable, and be protected against mechanical injury and vibration. In all fuel system installations, cleanliness is very important. Take precautions to prevent the entrance of moisture, dirt or contaminants of any kind during installation.

If possible, avoid the use of blended fuel of gasoline and methanol. Methanol can cause corrosion of metals and damage to plastic and rubber. Some blended fuels may have cosolvents in them to prevent damage, but the suitability of these fuels is not fully known at this time. Fuel containing alcohol can also cause external paint damage if spilled during refueling. Some states require the use of labels on pumps to indicate alcohol content. If unsure, ask the fuel station operator.

INSTALLATION

Any flexible fuel line installed between the fuel tank and the genset must meet USCG requirement 33CFR183.558 and be stamped "USCG TYPE A". There cannot be an electrical connection between the hose end fittings. A bad ground in the cranking circuit will cause a wire reinforced hose to become hot and ignite the fuel during cranking. If a metallic fuel line is run into the genset compartment, a length of flexible hose meeting the above specifications must be installed to absorb vibration from the genset.

⚠ WARNING *Ignition of fuel can cause fire and severe personal injury or death. Be sure any flexible fuel line used between the fuel tank and the generator set meets USCG requirement 33CFR183.558 and is stamped "USCG TYPE A".*



M-1679

FIGURE 7-1. INSTALLATION ABOVE TANK LEVEL

⚠ WARNING *Leakage of gasoline in or around the generator set compartment presents a hazard of fire or explosion and can cause severe personal injury or death. Do not permit any flame, spark, cigarette, pilot light, arcing equipment, or other ignition source near the generator set. The ventilation system must provide a constant flow of air to safely expel all fuel vapors.*

The fuel line should be run at or above level of the tank top to a point close to the engine connection whenever possible to prevent siphoning. See Figure 7-1. The line should be supported throughout its length with clips or straps spaced at no more than 14-inch (355 mm) intervals.

A separate fuel line is recommended for the genset. If a fuel tank is shared, a fuel line tee is *not recommended*. A tee can cause erratic set operation due to fuel starvation. The genset fuel pump has neither the capacity nor power to overcome the draw of the propulsion engine fuel pump.

If the fuel tank fitting is large enough, a second, shorter dip tube may be installed as shown in Figure 7-2. The required fittings can be built by a machine shop. Install an anti-siphon device at the tank fitting as shown.

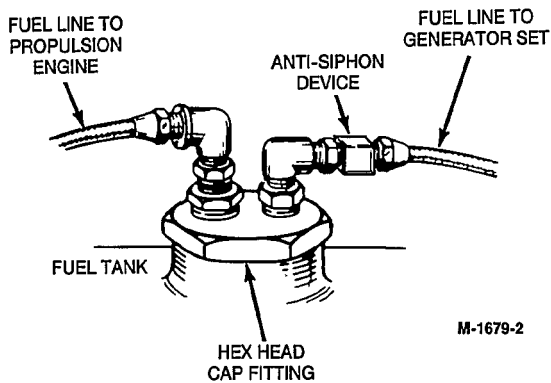


FIGURE 7-2. TWO FUEL LINES IN TANK FITTING

If the tank does not have an unused outlet, a new outlet can be installed. The metal tank must be removed to braze or weld a new outlet fitting. This procedure requires the service of a welder familiar with the essential safety measures.

⚠ WARNING *Ignition of fuel vapors can cause severe personal injury or death. Welding a fuel tank, empty or not, is extremely dangerous! Vapors may ignite causing an explosion and fire.*

Another consideration is the genset fuel pump lift capacity. The vertical height must not exceed 44 inches (1.1 m), minus the requirement of an anti-siphon valve when used, or genset operation can be adversely affected.

FUEL TANKS

A valve must be installed directly at the tank connection to shut off fuel flow. This valve may be electrically or manually operated. If electrically operated, it must be energized only during engine operation, and have a manual override to comply with USCG regulations. This electric valve can be purchased from Onan and is listed in the parts manual.

The manual valve must have an arrangement for operating it outside the compartment in which the tank is located, preferable from above deck.

A USCG approved service shutoff valve must be installed at the engine end of the fuel line under conditions listed below. This valve stops fuel flow when the genset is serviced.

- When fuel tanks are located in a compartment other than the engine.
- When the engine and fuel tanks are separated more than 12 feet (3.7 m).

If the propulsion engines and genset use different fuels, a separate fuel tank will be required. Use only an approved fuel tank designed for marine application. Be sure that the compartment is well ventilated (see *Ventilation System* section). Fuel consumption data in the Specifications section is useful for determining the tank size.

When installing a separate tank, locate it as close as possible to the genset compartment. Be sure it is accessible and can be removed for inspection.

⚠ CAUTION *Fuel starvation can cause marginal operation of the generator set. Fiberglass fuel tanks can present a problem if the fuel pick-up tube is too close to the tank bottom. Fiberglass fibers can settle and form a mat with time. Make a diagonal cut on the bottom of the pick-up tube and install 1/2 to 2 inches (13 to 51 mm) from the tank bottom.*

Mount the fuel tank and secure into position. The NFPA recommends that flat bottom tanks be installed on slatted wooden platforms to help prevent moisture condensation. Cylindrical tanks should be set in chocks or cradles and securely fastened.

Small fuel tanks can be suspended from deck beams. Support and brace the tank to prevent any movement. Line up braces with the tank internal baffle plates. Insulate all wood or metal surfaces from the tank surface with a non-abrasive and non-absorbent material. Heavy rubber-impregnated cotton fabric or oil and acid-resistant plastics work well.

⚠ WARNING *Ignition of fuel when filling the tank can result in severe personal injury or death. All metallic fuel tanks MUST be electrically bonded to the boat common ground. Also bond the filler neck or opening to the tank if a hose is used between them. This helps prevent static spark when filling that can ignite the fuel.*

Position the tank fill and vent pipes so fuel or vapor cannot escape into the bilge. Run the vent and fill pipes from separate openings in the tank. If the fill pipe has a flexible section of fuel hose, install a separate grounding wire between the deck fuel plate and tank. Install the vent opening as far from any other hull opening as possible and with a gooseneck so water cannot enter. Install a flame arrester on the vent opening.

FUEL LINES

The proper installation of fuel lines is very important. Give special attention to the following requirements.

- All fuel line materials must meet the requirements of both the USCG and the ABYC.
- Solid fuel lines must be seamless annealed, double-flared, and are approved for marine installations.
- Run fuel lines at the top level of tank to a point as close to the engine as possible to reduce danger of fuel siphoning should the line break.
- Keep fuel lines away from hot engine or exhaust areas. This reduces chance of vapor lock.
- Any locked-in torsional stresses must be avoided in the fuel line.
- If the flexible fuel line between the fuel pump and carburetor is damaged in shipment or during genset installation, be sure the replacement meets USCG requirement 33CFR183.558, and is stamped "USCG TYPE A." There cannot be an electrical connection between the hose end fittings. A bad ground in the cranking circuit will cause a wire reinforced hose to become hot and can ignite the fuel during cranking.

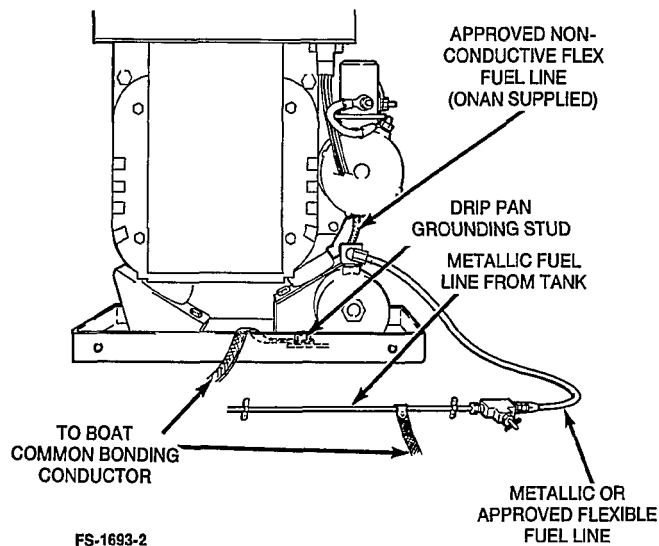


FIGURE 7-3. FUEL LINE BONDING

- Install fuel lines so they are accessible and protected from damage. Do not allow contact with hot, sharp or abrasive surfaces.
- Use non-ferrous metal straps without sharp edges to secure the fuel lines every 14 inches (355 mm).
- Electrically bond a metallic fuel line to the vessel common bonding conductor with a suitable bonding strap. The drip pan must also be bonded to this same conductor as shown in Figure 7-3.

SIPHON PROTECTION

A carburetor float valve cannot be trusted to stop fuel flow if there is gravity feed from the fuel tank. When the tank is installed above the engine level an anti-siphon device is needed to prevent the fuel from emptying into the carburetor if the float valve does not close. It also prevents siphoning if the line breaks at a point below the fuel level.

Mandatory siphon protection must be provided by installing a U.S. Coast Guard approved anti-siphon device. See Figure 7-4. This device can be installed at the tank withdrawal fitting, or at a location where the line from the fuel tank will no longer remain above the fuel tank top level. The device can be either a mechanical check valve (1 ± 0.5 psi [6.9 ± 3.5 kPa]), or an electric valve with mechanical override. The electric valve must be connected so it operates only when the engine ignition is on.

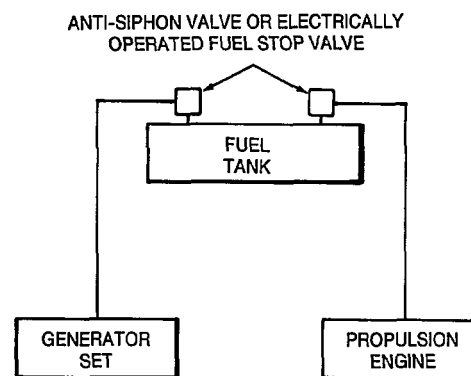


FIGURE 7-4. SIPHON PROTECTION

FUEL SYSTEM TEST

After installation, test the fuel system for tightness per USCG specification 33CFR183.542. Any leak must be found and corrected before putting the fuel system into service.

Section 8. Electrical System

GENERAL

All wiring must meet Coast Guard, NFPA, and all other applicable codes. Have all wiring installed by a qualified electrician. Onan wiring diagrams do not include components added by customers.

⚠ WARNING *Faulty electrical equipment can cause shock and severe personal injury or death. Use only approved power supply assemblies, and never remove the grounding pin from the power cord. Incorrect or no ground may cause the vessel to be electrically "hot".*

LOAD CONNECTIONS

While at dock, most boats have a dockside connection for use of commercial power. These installations must have a transfer switch to isolate the genset and the commercial power. The two power sources **must never** be connected together. A manual transfer switch is available from Onan for this function. See Figure 8-1.

⚠ WARNING *Ignition of explosive fumes can cause severe personal injury or death. The load transfer switch cannot be used in a gasoline fueled environment unless certified for such use. Separation by a bulkhead or deck is necessary.*

Use a section of flexible conduit at the genset to absorb vibration. Flexible, multistrand wire must be used throughout to reduce the danger of breakage due to boat movement or vibration.

The 60 hertz genset is available only for 120-volt, two-wire connection as shown in Figure 8-2. An AC output circuit breaker is supplied only on the 60 hertz genset.

The 50 hertz genset has four output wires. Depending on the model and wire connections, the voltage available is either 110/220V, or 120/240V. See Figure 8-3. When the output is taken from two generator windings, such as 110/220V, the load must be balanced across the two windings. Taking full load from only one winding can cause poor regulation and damage to the generator. A 240-volt or 220-volt load is connected across both windings. The AC output breaker (not furnished with the genset) must be sized according to the AC output current.

REMOTE STARTING CONTROLS

Onan has a standard and a deluxe control panel kit available for remote starting and stopping of the genset. The standard control has a start/stop switch with a lamp that glows when the genset is running. The deluxe control has a start/stop switch with lamp, a battery condition meter, and a running time meter. The kits come with installation instructions and wiring diagrams. Connections are also shown on Figure 8-2 and 8-3 wiring diagrams.

Multiple remote stations are possible with parallel wiring. The genset can be started and stopped from any station, including the set itself.

⚠ CAUTION *Interchanging the connections shown on the instruction sheet or the generator set wiring diagrams can cause equipment damage.*

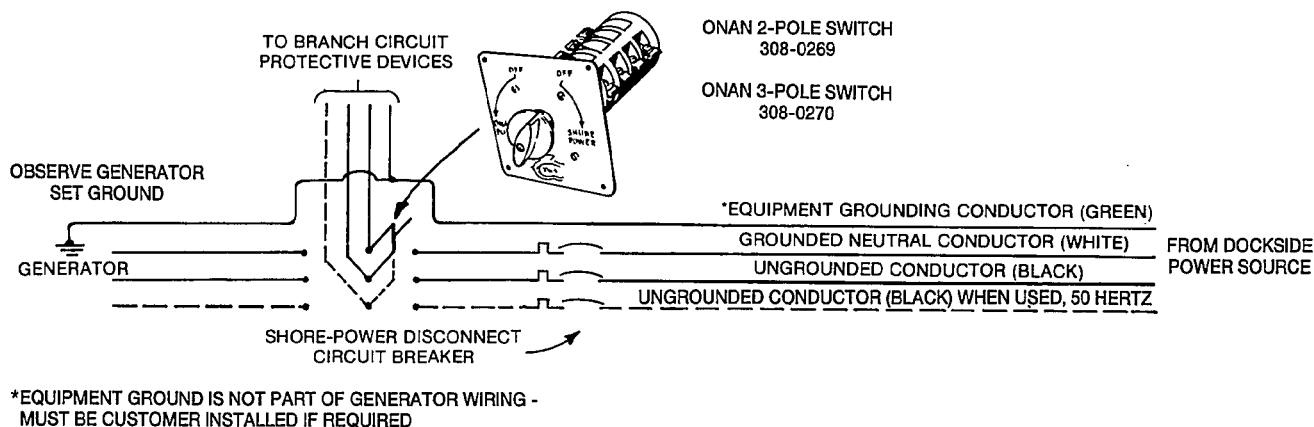


FIGURE 8-1. TYPICAL MANUAL TRANSFER SWITCH CIRCUIT

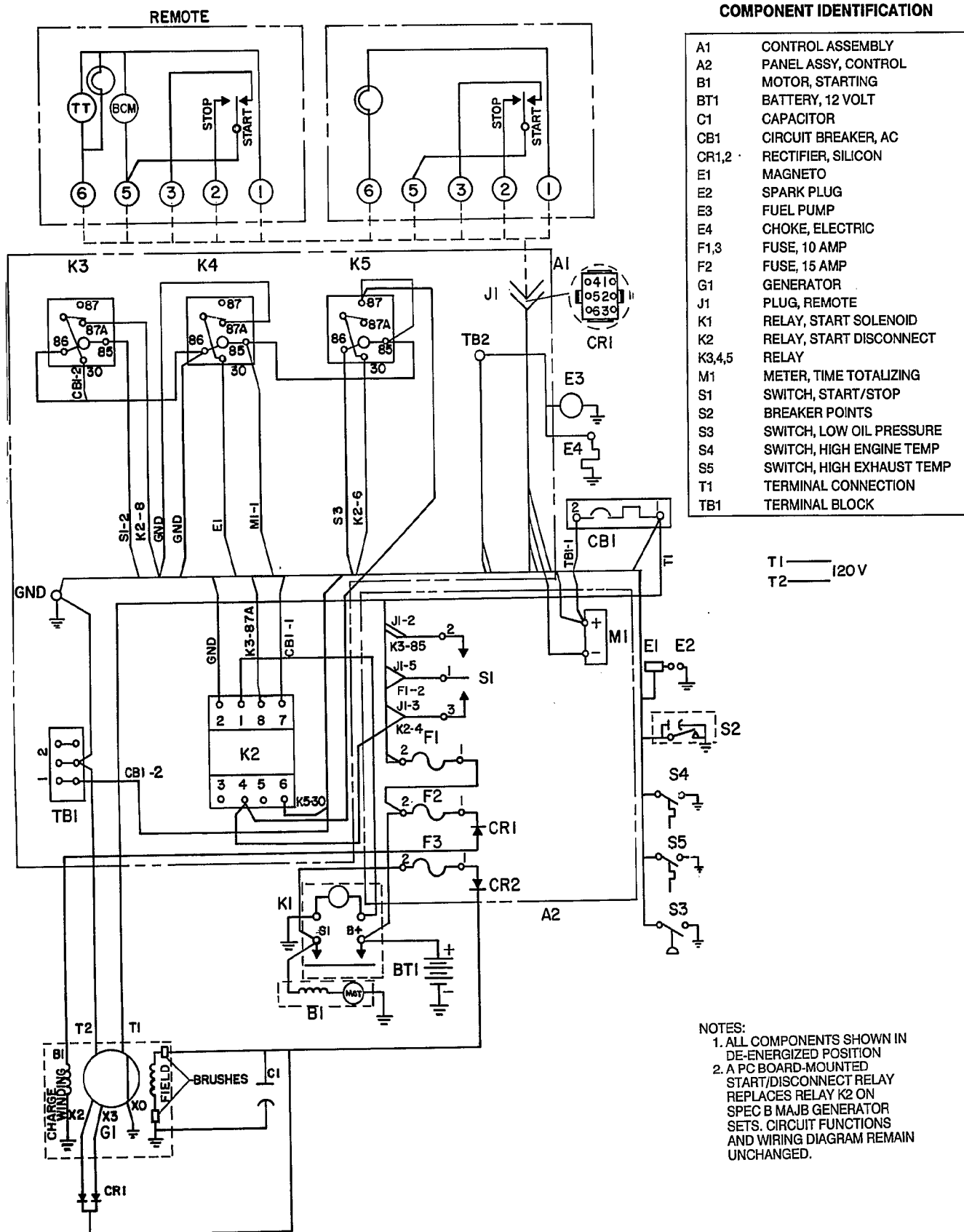
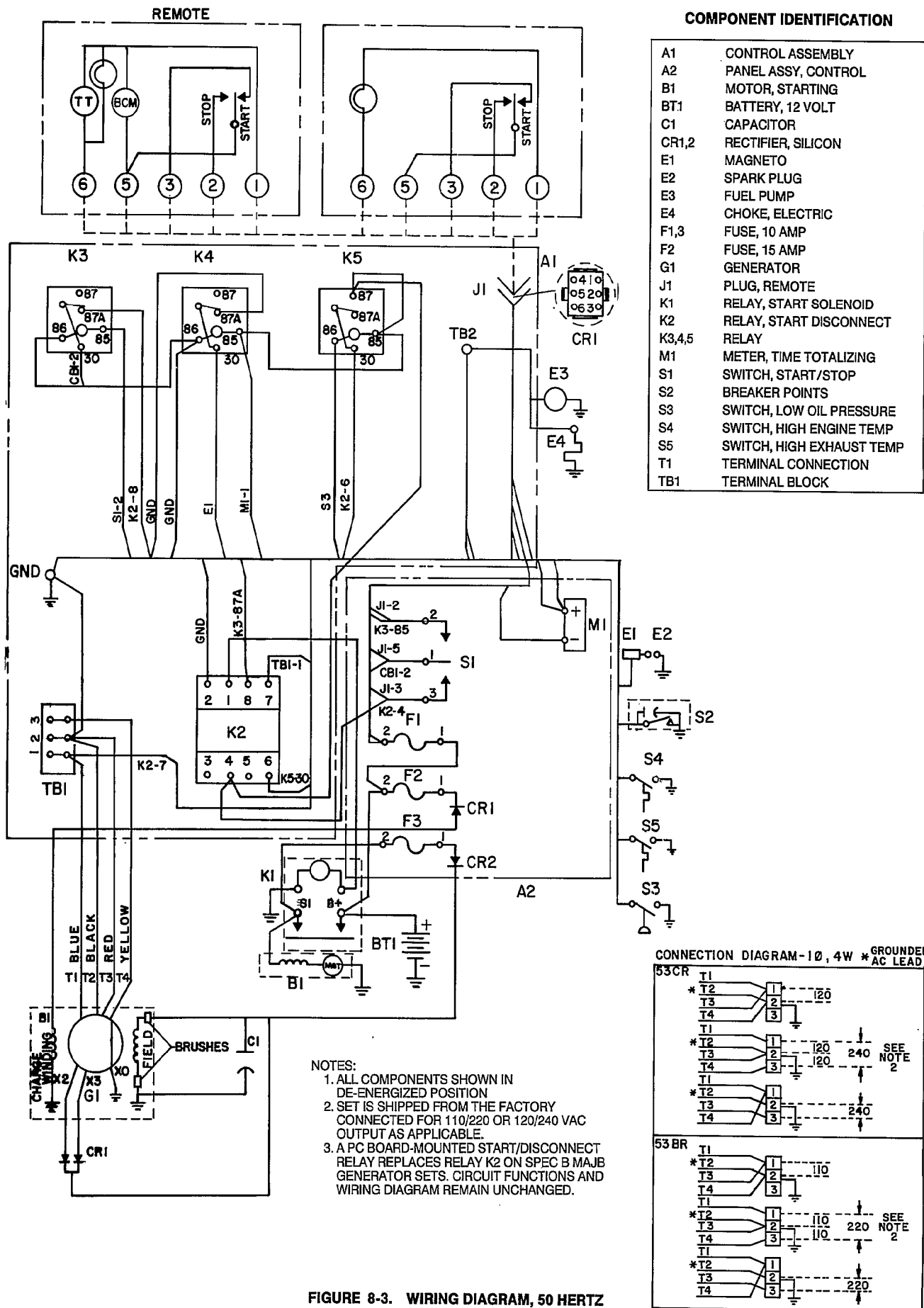


FIGURE 8-2. WIRING DIAGRAM, 60 HERTZ



BATTERIES

General

Always use a battery at least as large as specified. The battery should be installed close to the genset, preferably in a separate compartment. The compartment must be well ventilated to prevent accumulation of explosive battery gases.

Mount the battery in an acid resistant tray on a platform above the floor. It must be secured to prevent shifting. If mounted in an engine compartment, always install a non-metallic cover to prevent battery damage and arcing from accidentally dropped tools. Figure 8-4 shows a typical battery tray and cover.

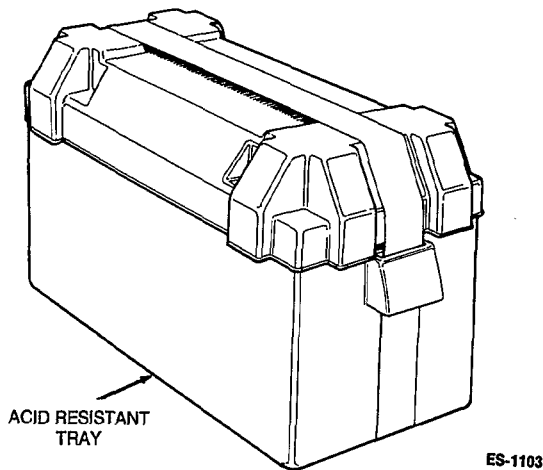


FIGURE 8-4. TYPICAL BATTERY TRAY AND COVER

Maintenance free batteries definitely should be considered for marine application. New technology of these batteries make them completely sealed and maintenance free. They offer higher output (CCA) and better durability.

⚠ WARNING Leakage of fuel in or around the generator set compartment presents a hazard of fire or explosion that can cause severe personal injury or death. Do not disconnect or connect battery cables if fuel vapors are present. Ventilate the compartment thoroughly with the bilge blowers or power exhausters.

Using cable size specified in Table 8-1, connect the battery negative (-) lead to the genset at the location shown in Figure 8-5. Failure to do so can cause arcing or resistance in the cranking circuit. Connect the battery positive (+) lead to the start solenoid as shown.

⚠ WARNING The ignition of gasoline fuel or fumes can result in severe personal injury or death. Connect the generator set battery ground (-) lead only at the location shown.

Connect the cables to the battery as shown in Figure 8-5. Always connect the negative (-) battery terminal last; and disconnect it first. Be sure the battery connections are clean and tight; then cover the battery terminals with a dielectric grease to retard corrosion.

TABLE 8-1. BATTERY CABLE SIZE REQUIREMENTS
(Maximum Length of One Cable)

Cable Size	2	1	0	00	000	0000
Length	4 ft (1.2 m)	5 ft (1.5 m)	7 ft (2.1 m)	9 ft (2.7 m)	11 ft (3.4 m)	14 ft (4.3 m)

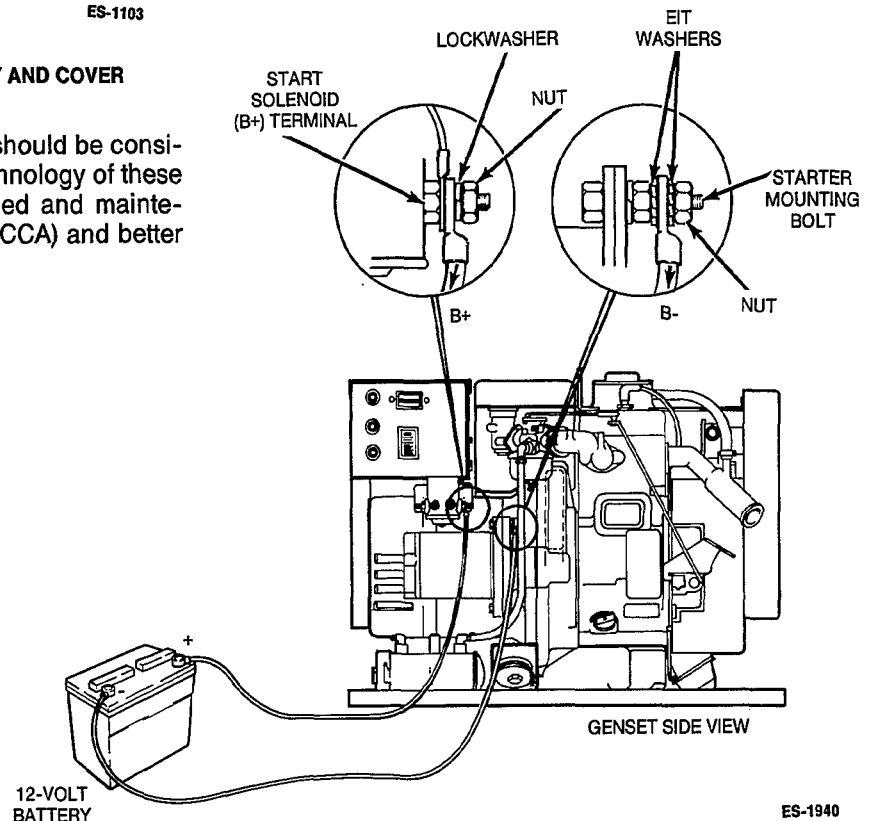


FIGURE 8-5. BATTERY CABLE CONNECTIONS

Grounding

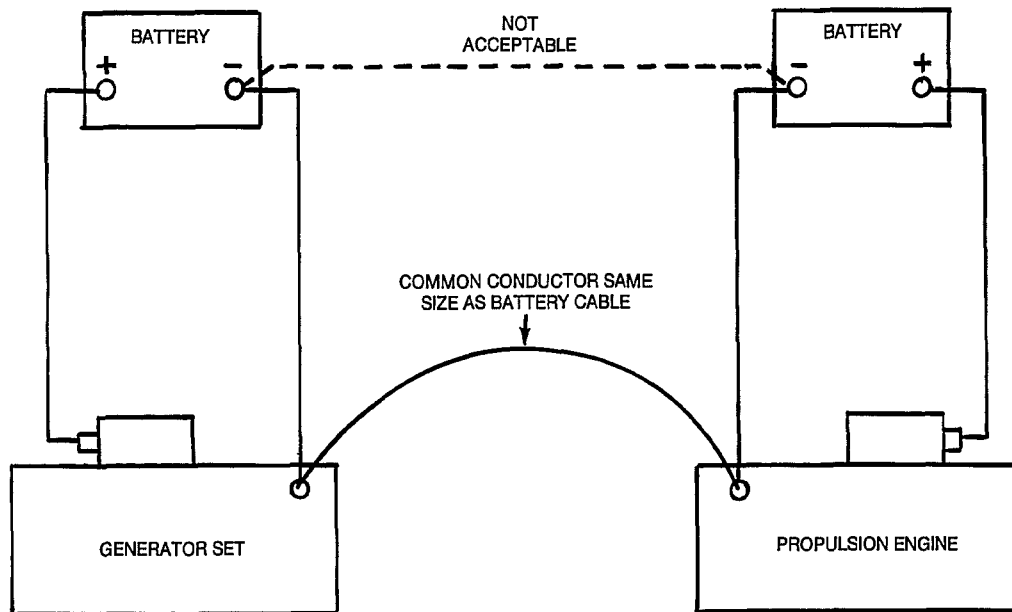
The genset requires the battery connected negative ground. Most propulsion engines and vessel electrical equipment have negative ground systems.

The genset and propulsion engine/s must be grounded in accordance with USCG regulation 33CFR183.415. The regulation requires a common ground conductor connected between the genset and propulsion engine cranking motor circuits. The conductor must be the same size as the largest battery cable. See Figure 8-6.

The conductor prevents accidental passage of cranking current through the fuel systems and smaller electrical conductors common to the engines. This can happen if a cranking motor ground circuit becomes resistive or opens from corrosion, vibration, bad cable, etc.

⚠ WARNING *Improper ground can cause severe personal injury or death from fire or explosion. Be sure to install a common ground conductor between all on board cranking circuits.*

Do not connect the battery negative lead to the genset at a location other than shown in Figure 8-5.



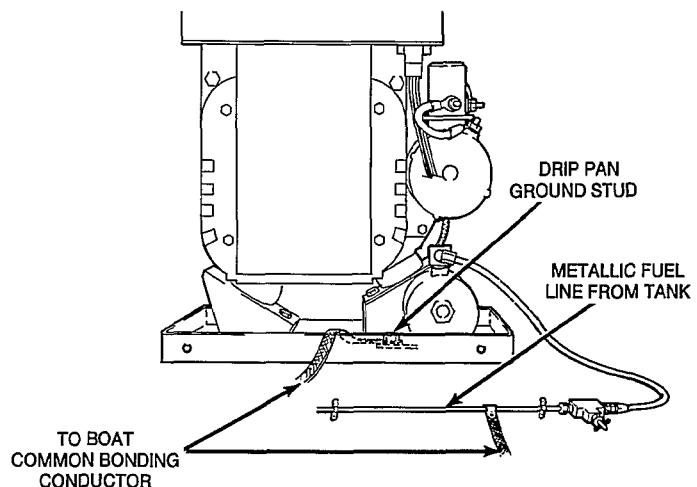
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FIGURE 8-6. COMMON GROUND CONDUCTOR

Bonding

The genset must be bonded to the vessel common bonding conductor with a bonding strap attached to the drip pan as shown in Figure 8-7. Either fuel pump mounting stud may be used for this purpose.

If a metallic fuel line is installed between the fuel tank and the genset shutoff valve, it too must be bonded to the same vessel common conductor.



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FIGURE 8-7. BONDING CONNECTIONS

Section 9. Final Installation Checks

INSTALLATION CHECKS

Before trying to start the genset, determine that the installation is complete by answering affirmatively the following questions:

- Is the exhaust system secure and all connections tight?
- Is a flexible section of exhaust hose used between the genset and muffler?
- Is all exhaust hose certified for marine exhaust application, and adequately supported and protected?
- Is the exhaust outlet terminated away from windows, vents or other openings that might allow exhaust gases to enter the vessel, or be pulled into the vessel when in motion?
- Are the AC generator and load wires securely and correctly connected to the circuit breaker?
- Are the battery cables connected correctly and securely at the genset and battery?
- Has crankcase oil been added to the engine, and at the correct level? See the Maintenance section of the Operator's Manual.

⚠CAUTION

Oil and fuel have been drained from the engine at the factory prior to shipment. Operation without oil will damage the engine.

INITIAL STARTING AND CHECKS

Refer to the Operator's Manual before trying to start the genset. Make sure the fuel shutoff valve and sea water cock are open. Operating the sea water pump without water will ruin the neoprene impeller.

⚠WARNING

Gasoline vapors can cause an explosion and fire resulting in severe personal injury or death. Before starting the generator set, operate the bilge blower for a minimum of 4 minutes. If fuel fumes are present, locate the source and correct prior to generator set operation.

1. Start the genset by holding the Start/Stop switch in the Start position. The genset should start within a few seconds. If not, check fuel supply and shutoff valve/s.
2. Check the hull exhaust outlet for water flow and the genset operation. Refer to Operator's Manual for proper parameters.
3. Check the exhaust system for leaks, visually and audibly. Note the security of the exhaust system supports. If any leaks are found, shut down the genset immediately and repair.

⚠WARNING

Exhaust gas is deadly. For this reason, shut down the generator set immediately if an exhaust leak or exhaust component needs repair. Do not run the generator set until the exhaust system is repaired.

4. Check the genset for fuel, oil or coolant leaks. If any are found, shut down the genset and repair the leak before making any more checks.
5. Connect an accurate AC voltmeter and frequency meter across two line terminals. Apply load to the generator and check output voltage and frequency.

Output frequency is determined by engine speed and normally does not require adjustment. Verify that frequency is correct before making any voltage adjustments. Call an authorized Onan distributor or dealer for assistance if needed.

If the voltage is not within specs, it can be adjusted as shown in Figures 8-2 and 8-3. Before making any adjustments, disable the genset by removing the negative (-) cable at the battery.

⚠WARNING

Accidental starting of the generator set can cause severe personal injury or death. Disconnect the negative (-) battery cable before adjusting the regulator transformer taps.





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